

THE PUPA OF *EPACMUS LITUS* (COQUILLET), ANOTHER  
TAXON OF BEE FLIES LACKING CEPHALIC SPINES  
(DIPTERA: BOMBYLIIDAE)

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*Abstract.*—The pupa of *Epacmus litus* (Coquillett) (Diptera: Bombyliidae) is described for the first time. The significance of the lack of cephalic spines in this genus and others in the Bombyliidae is discussed.

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In September of 1984, Saul I. Frommer, Senior Museum Scientist in the Department of Entomology, University of California, Riverside, presented me with the parasitized remains of an unidentified ethmiid (Lepidoptera) cocoon along with the pupa of its parasite, a brachycerous dipteran. The pupal case of the parasite contained an adult close to emergence, the head features, legs, and abdominal segments all clearly visible through the nearly translucent sclerotized pupal case. The adult keyed to *Epacmus litus* (Coquillett), a representative of the bombyliid subfamily Aphoebantinae, and a common species in southern California and Arizona during the months of September and October.

Since the immature stages of most Bombyliidae are unknown, this record is an important contribution to the knowledge of the biologies of these flies. The only previous records of Aphoebantinae immatures are those of *Aphoebantus hirsutus* Coquillett and *A. mus* (Osten Sacken) on the warrior grasshopper, *Camnula pelucida* (Scudder) (Riley, 1880, 1881a, 1881b; Wilson, 1936), *Petrorossia* on various Hymenoptera (Aldrich, 1928; Dutt, 1912; Evenhuis and Arakaki, 1980), and *P. feti* Zaitsev & Charykuliev on the egg cocoon of the spider *Uroctea limbata* (Zaitsev & Charykuliev, 1981). This marks the first host record and pupal illustration for the genus *Epacmus* Osten Sacken, and the first lepidopterous host record for this subfamily.

***Epacmus litus* (Coquillett)**

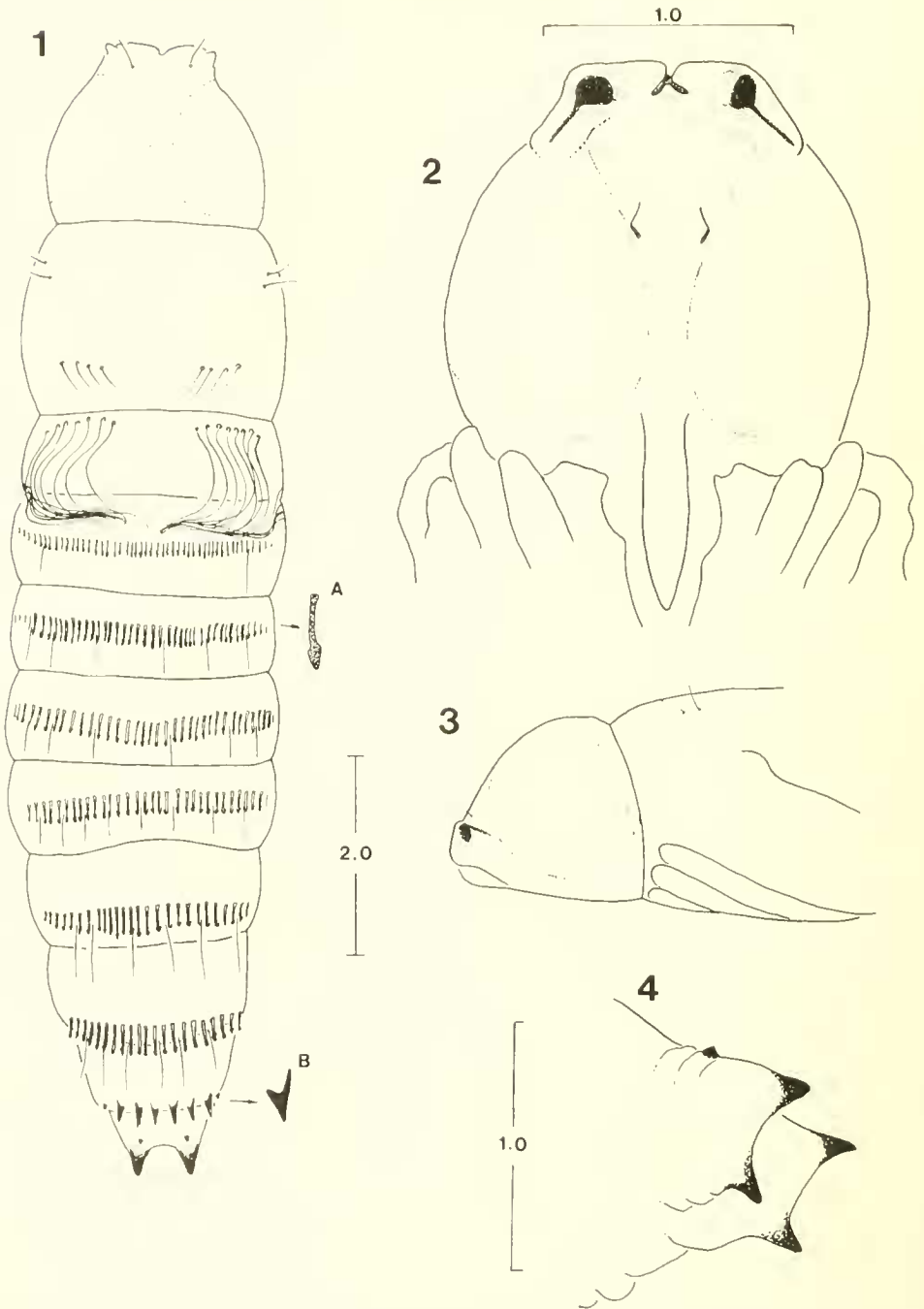
Figs. 1-4

*Aphoebantus litus* Coquillett, 1886: 84.

*Epacmus litus* (Coquillett), Melander, 1950: 11.

Pupa. Length: 8.5 mm. Head width: 1.65 mm. Thorax width: 1.90 mm. Abdominal width: 2.15 mm, tapering to 1.25 mm at width of anal segment. Pigmentation: generally light brown overall; dorsal abdominal chitinous rods and caudal spines brown; setae amber dorsally, yellow to pale yellow laterally and ventrally.

Head: In lateral view with front produced, not heavily chitinized, without



Figs. 1-4. *Epacmus litus* (Coquillett), pupa. 1, Dorsal view; a, detail of chitinous rods on abdominal tergites II-VII; b, detail of spines on abdominal tergite VIII. 2, Head, ventral view. 3, Head, lateral view. 4, Segment IX (anal segment), ventrolateral angle.

cephalic armature; antennal sheaths prominent, extending ventrolaterally, sheaths separate basally. In ventral view with proboscis sheath extending caudally to thorax, tip of proboscis located between fore coxal sheaths; anterior tentorial pits evident, located approximately  $\frac{3}{8}$  distance from antennae to proboscis. In dorsal view with one pair of setae located just posterior to antennal sheaths.

*Thorax:* Dorsally, with 2 pairs of anterodorsal setae, 4 pairs of admedial posterior setae. Prothoracic spiracle small, inconspicuous, slightly darker sclerotized than surrounding area, flush with surface, located directly posterior to head and above fore coxal sheath. Dorsum of thorax smooth, without evident texture; base of halter sheath evident laterally above wing pad.

*Abdomen:* Segment I with 8 pairs of long, curved setae dorsally, extending onto anterior portion of segment II, 4 pairs of long, lateral setae, also extending onto anterior portion of segment II, intertwining with dorsal setae; segment II with 48 dark, arrow-shaped, chitinous rods, oriented longitudinally, extending transversely across dorsum of segment onto upper lateral portions, 1 pair of short dorsal and 4 pairs of long lateral setae; segment III with 42 dorsal rods, 3 pairs of short dorsal and 3 pairs of longer lateral setae; segment IV with 36 dorsal rods, 3 pairs of short dorsal and 3 pairs of longer lateral setae; segment V with 32 dorsal rods, 4 pairs of dorsal and 3 pairs of lateral setae; segment VI with 26 dorsal rods, 3 pairs of dorsal and 3 pairs of lateral setae; segment VII with 22 dorsal rods, rods longer than on preceding segments, 3 pairs of dorsal and 3 pairs of lateral setae; segment VIII with 6 short, black, spine-like chitinous protuberances plus 1 rudimentary spine each side of dorsal spines, no setae present dorsally or laterally; segment IX (anal segment) with 2 lobes, each lobe possessing a single large darkly sclerotized dorsal and ventral-oriented spine, a single large darkly sclerotized dorsal and ventral-oriented spine, a single small rudimentary sclerotized tubercle anterior to each dorsal spine. Ventrally, segments II–VI with one pair of sublateral setae; segment VII with 4 setae sublaterally; abdominal spiracles small, slightly raised above surface, brown, present laterally on segments I–VII.

Certain features of the pre-emergent adult are apparent through the translucent chitin of the pupal case: Antennae black, segment III onion-shaped basally, with long terminal style apically; eyes red, smoothly indented along posterior margin; eyes separated at vertex by ca.  $2\times$  width of ocellar tubercle; wing pads with vague indications of venation anterobasally; legs fully formed, tibiae and tarsi with typical spicules and spines; claws black; pulvilli not evident; abdominal segments with heavy fat deposits; apex of abdomen retracted away from anal segment leaving pupal segments VIII–IX clear; apical abdominal segment of pre-emergent adult valvulate and spread showing thickened cerci of female genitalia; hooked spines evident on acanthophorites.

Material examined: 1 female pupal specimen in alcohol, California: Riverside County: Sec. 33, T.75, R.1E, Site I,  $116^{\circ}52'30''\text{W}$ ;  $33^{\circ}32'30''\text{N}$ , ca. 5 mi [8.0 km] N of Aguanga, 13.X.1978, E. M. Fisher, ex sifted soil below *Simmondsia*, collection 302326, Jobja project.

#### DISCUSSION

Most bombyliid pupae possess heavily sclerotized cephalic processes called spines. These spines are used during the pre-emergent adult phase when the pupa

must dig its way out of earthen cells in which it has spent its parasitic or predaceous immature life (e.g., on grasshopper egg pods, solitary bees and wasps, tiger beetles, armyworms and cutworms, etc.). The pupa of *E. litus* represents the first bombyliid outside of *Toxophora* Meigen, *Geron* Meigen, *Systropus* Wiedemann, and taxa within the Mythicomyiinae (viz., *Glbellula* Loew and *Psiloderoides* Hesse) to lack these spines. The fact that this species of *Epacmus* lacks the cephalic spines is most likely indicative of an independently derived character. Other genera in this subfamily have pupae that possess distinct sclerotized cephalic spines [*Aphobantus* Loew (Hull, 1973) and *Petrorossia* Bezzi (Evenhuis and Arakaki, 1980; Zaitsev and Charykuliev, 1981)]. The implications of the findings in this study may have a bearing on using the lack of cephalic spines as a character in grouping together so-called "primitive" genera or subfamilies, and separating them from typical bombyliid taxa. Pupal head capsules of the latter possess two and often three pairs of cephalic spines anteriorly and anteroventrally. Rather than representing a phylogenetic character defining a monophyletic grouping of primitive taxa, the lack of such ornamentation on the pupal head capsule in bombylioid Diptera is instead homoplasious and apparently closely associated with specialized parasitic habits. Supporting evidence for this theory includes the fact that those other genera that lack cephalic spines do indeed have rather specialized parasitic habits: *Systropus* is found almost exclusively on Limacodidae (Lepidoptera), *Toxophora* is found primarily on twig-nesting species of Eumenidae and Sphecidae (Hymenoptera), *Geron* is found primarily on Psychidae (Lepidoptera), *Glbellula* is found as an inquiline in nests of *Formica* (Hymenoptera), and *Psiloderoides* is found as a superparasite of Acridoidea [see DuMerle (1975) for complete host records of these taxa and others in the Bombyliidae]. Whether *Epacmus* is also specialized in its parasitic habit will have to await further host records for the genus; however, the lepidopterous host recorded here is the first such record for any aphobantine representative; all others in this subfamily are parasitic or predaceous on either Acridoidea, Hymenoptera or spiders.

#### ACKNOWLEDGMENTS

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